Highlights of bioeconomy related research in Bulgaria

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EC 2012 Bioeconomy Strategy defined the **bioeconomy** as "the production of renewable biological resources and the conversion of these resources and waste streams into value-added products, such as food, feed, bio-based products as well as bio-energy".

The major aim of the strategy, therefore, was "to pave the way to a more innovative, resource efficient and competitive society that reconciles food security with the sustainable use of biotic renewable resources for industrial purposes, while ensuring environmental protection"

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Funding sources:

International: FP EU, Bilateral programs, International organizations, International companies etc.

National:

- **National Science Fund**
- **Operational Programme "Science and Education for Smart Growth" 2014-2020** (Industry for healthy living and biotechnology)
  - *Centre of Excellence*
  - *Center of Competence*
- **Action 16.1. OP Rural Development, Ministry of Agriculture, Food and Forestry**

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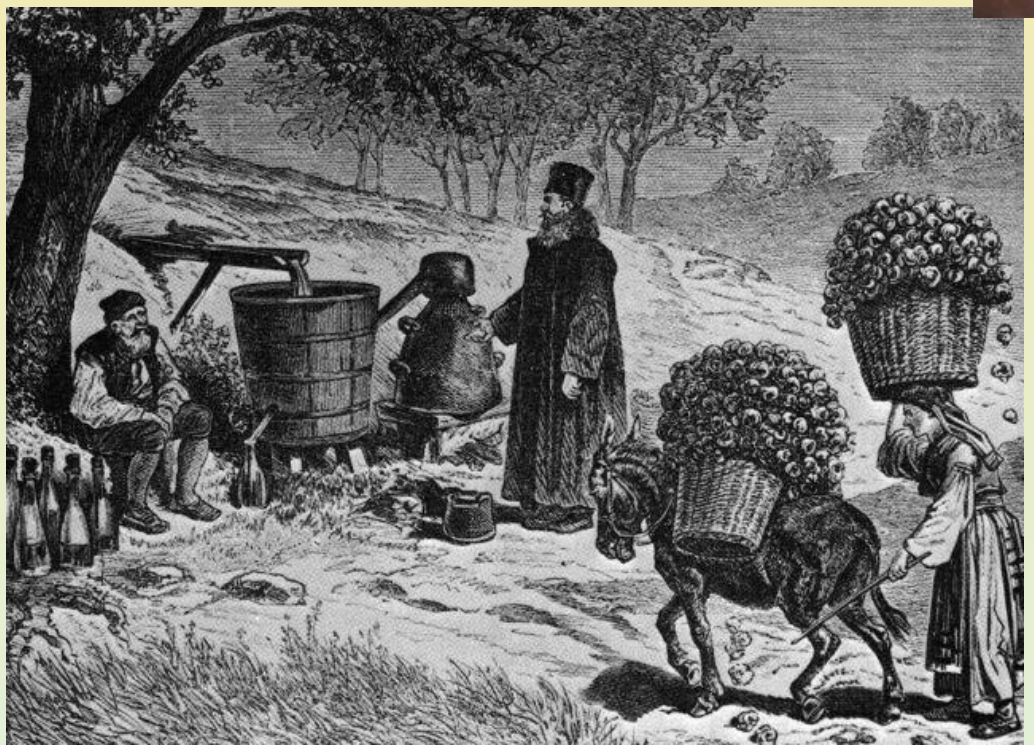


rose oil production has a century old tradition,

rose oil is produced by water & steam distillation of fresh rose flowers

Bulgaria – Land of Roses and Rose Oil,

but what about the waste…

1 kg rose oil is produced after water & steam distillation of about **3000 kg fresh rose flowers** and results in discharge of **about 7500 L** ***rose oil distillation waste water (RODW) and flower debris***

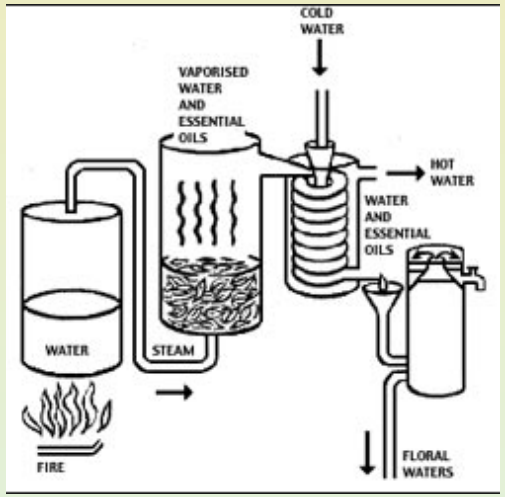
an industrial rose oil distillation cycle involves:

3000 kg rose flowers

1 kg rose oil

distiller
2.5 hour, 100oC

12000 liters water



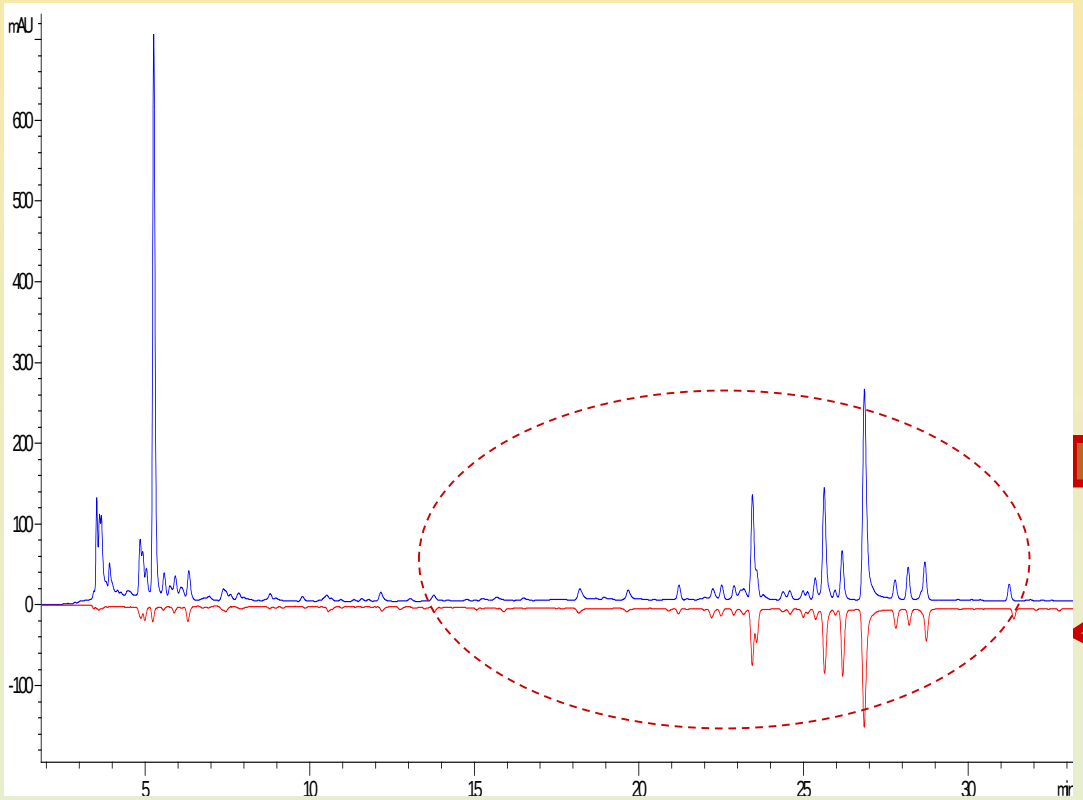
hot (80-90oC) rose oil distillation wastewater & rose flower remedies

>> some RODW parameters:

- **total phenolics about 1400 mg/L (GAE)**
- **total sugars about 3000 mg/L (glucose, DNS)**
- **pH 4.0 ÷ 4.3**

>> processing of RODW is largely complicate by the its high temperature after discharge from the distiller and presence of large quantity of fine rose flower particles

Extraction procedure of bioactive phenolics, developed as part of the joint Bulgarian – Swiss project:

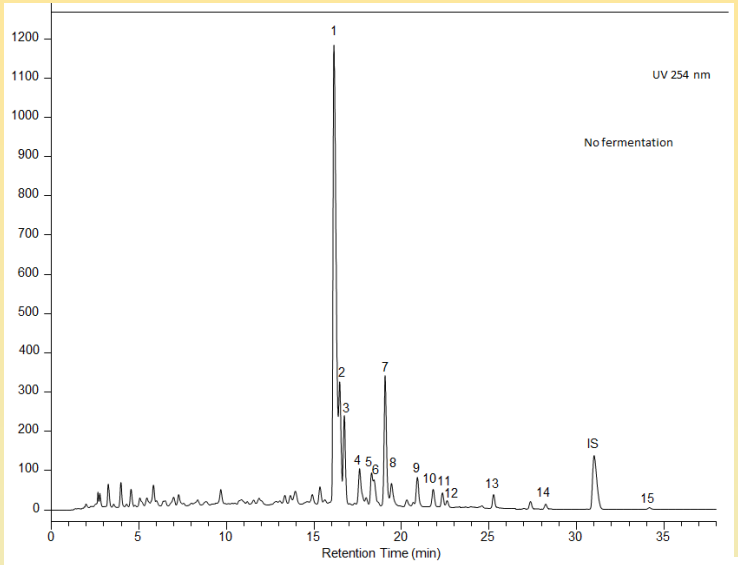


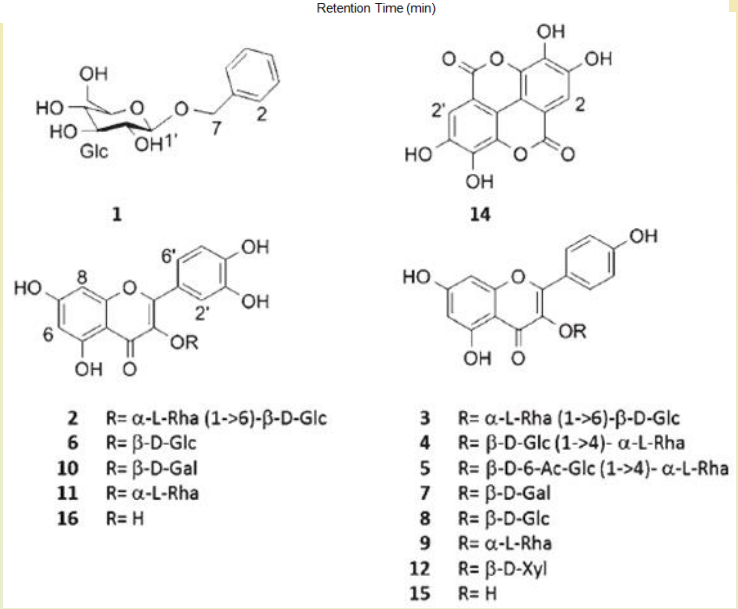
RODW

RODW extract

HPLC-UV analysis of phenolics in RODW and RODW extract

> composition of the RODW phenolics & extracts



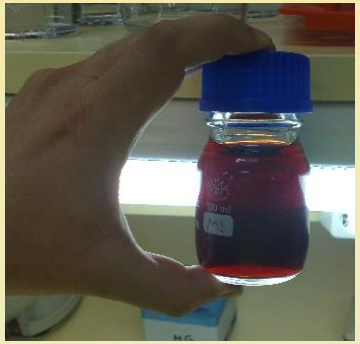


Peak	Identity	LC/MS, NMR
15	Kaempferol	LC/MS, NMR
9	Kaempferol-3-O-rhamnoside	LC/MS, NMR
5	Kaempferol-3-O-acetylglucosylrhamnoside (Multiflorin A)	LC/MS, NMR
4	Kaempferol-3-O-glucosylrhamnoside (Multiflorin B)	LC/MS, NMR
13	Kaempferol-3-O-arabinoside	LC/MS, NMR
12	Kaempferol-3-O-xyloside	LC/MS, NMR
8	Kaempferol-3-O-glucoside (Astragalin)	LC/MS, NMR
3	Kaempferol 3-O-rutinoside	LC/MS, NMR
7	Kaempferol-3-O-galactoside	LC/MS, NMR
q	Kaempferol galloylhexoside	LC/MS
s	Kaempferol acetyldisaccharide	LC/MS
16	Quercetin	LC/MS, NMR
2	Quercetin-3-O-rhamnosylglucoside (Rutin)	LC/MS, NMR
10	Quercetin-3-O-galactoside (Hyperoside)	LC/MS, NMR
6	Quercetin-3-O-glucoside (Isoquercitrin)	LC/MS, NMR
11	Quercetin-3-O-rhamnoside (Quercitrin)	LC/MS, NMR
p	Quercetin O-methyl disaccharide	LC/MS
o	Quercetin galloylhexoside	LC/MS
n	Quercetin di-deoxyhexose pentoside	LC/MS
m	Quercetin galloylhexoside	LC/MS
l	Quercetin O-methyl-dihexoside	LC/MS
j	Quercetin O-dimethyl trisaccharide	LC/MS
h	Quercetin O-methyl trisaccharide	LC/MS
r	Quercetin acetyldisaccharide	LC/MS
1	Phenylethyl-glucopyranoside	LC/MS
14	Ellagic acid	LC/MS
a	Flavan-3-ol hexoside	LC/MS
g	Flavonol trisaccharide	LC/MS
d*	**Flavonol**	**LC/MS**
e*	**Flavonol disaccharide**	**LC/MS**
f*	**Flavonol galloylpentoside**	**LC/MS**
i*	**Flavonol galloylglycoside**	**LC/MS**
b*	**Flavanone disaccharide**	**LC/MS**

Rusanov et al. Recovery of Polyphenols...
Planta Med. 2014; 80: 1657-1664

small scale extractions

N x 100 - 400 ml

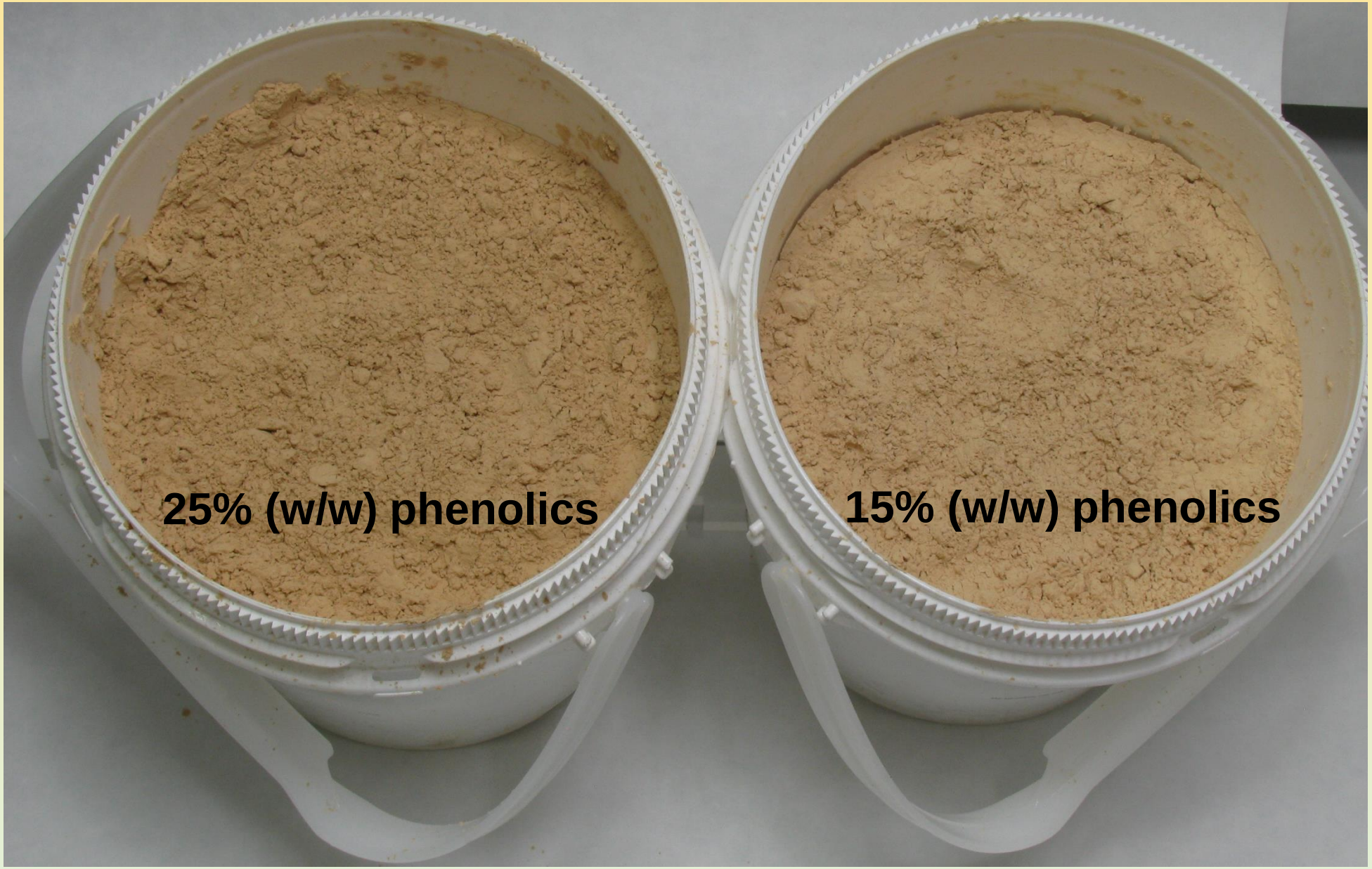


semi-industrial extraction volumes

N x 200 L

concentration &
spray drying

Spray dryed RODW extract

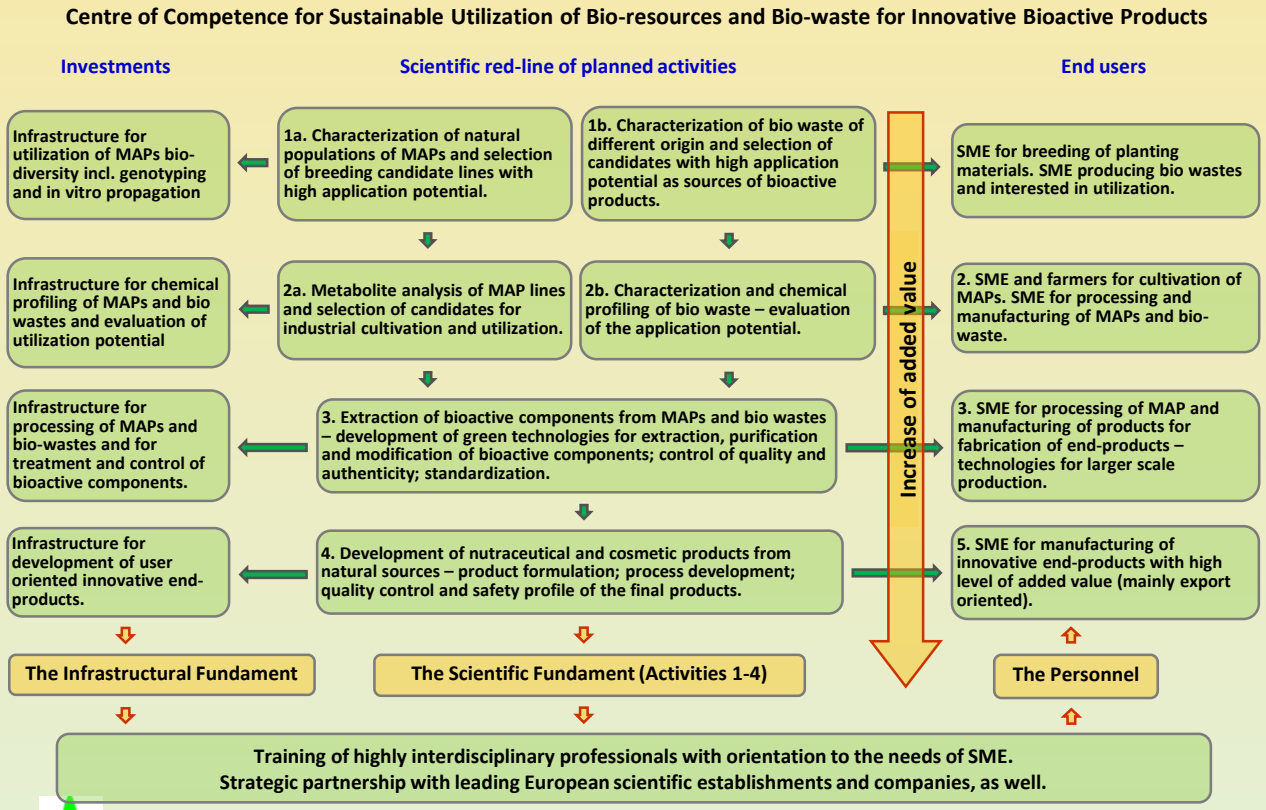


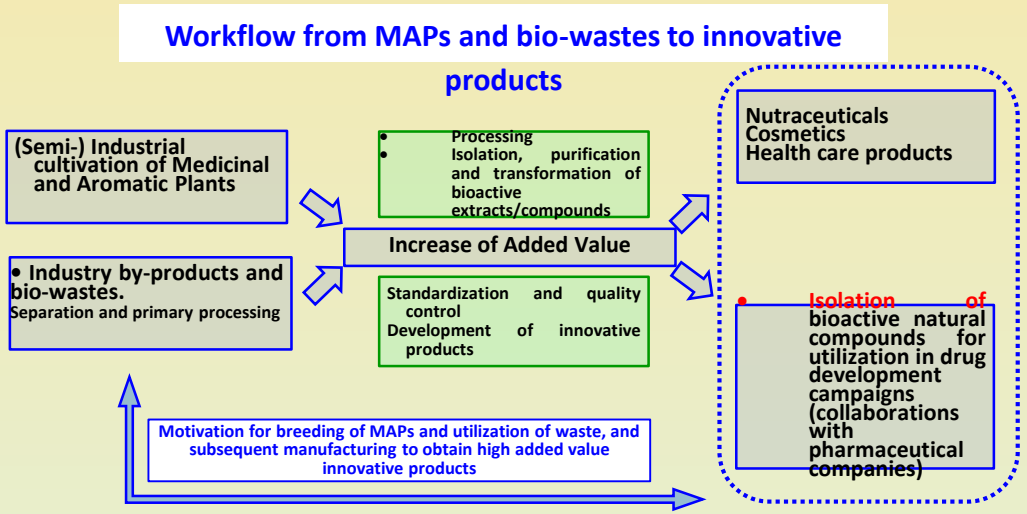
The main lesson we learned approaching the agro-industry

- the industry is not or less attracted by the looking very attractive opportunities which involve only a “partial” processing and intermediate products without substantial characterization and information on their potential use….

Solutions … development of research chain infrastraction and consortia with capacity to address all steps and research necessary to reach well characterized “final” products….

Centre of Competence for Sustainable Utilization of Bio-resources and Bio-waste for Innovative Bioactive Products





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Thank you for your attention